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AUTHOR Tivendale, Bruce D.
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ABSTRACT

Soil is a natural resource of inestimable value. It is classified as a renewable resource, but because it may take from a few hundred years to a few thousand years to be renewed, it is more accurately termed an exhaustible resource. The emphasis of this teaching unit is the importance of soil and the need and means to conserve it. The constraining principle behind these student exercises is that soil erosion is generally to be found outside, therefore teachers are urged to use the outdoors as the learning laboratory as often as is practicable. Alternative indoor activities are included when outdoor work is inconvenient. This unit includes a teacher's guide and student guide. Slide tape sets are available. The unit includes the following sections: (1) "The Importance of Soil"; (2) "Soil Loss--How Does It Start?"; (3) "Factors That Affect Soil Erosion"; (4) "The Effects of Soil Erosion"; (5) "Putting a Stop to Soil Loss"; and (6) "Planning Avoids the Problem." (KR)

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SOIL CONSERVATION

A guide to classroom and field activities for middle secondary students

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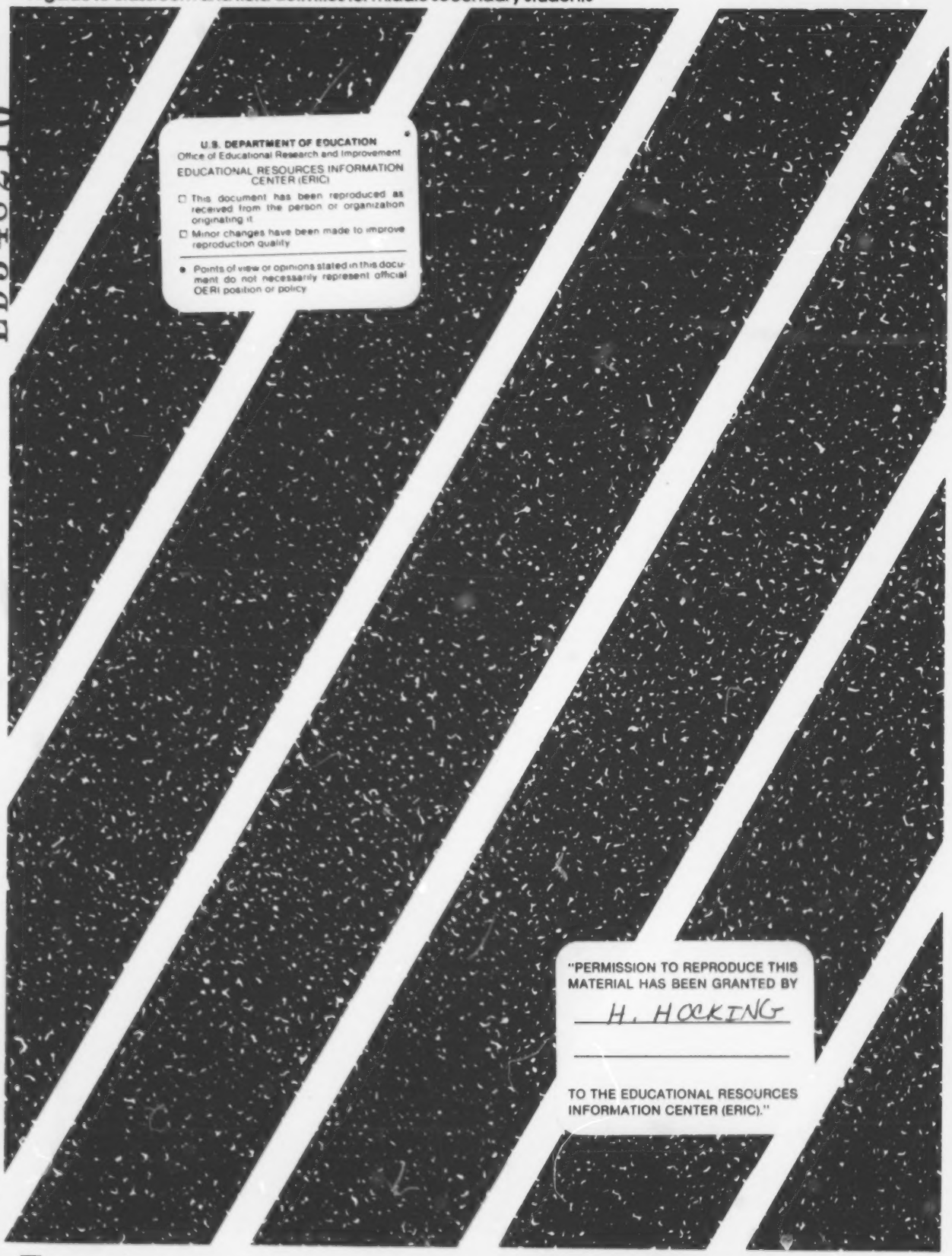

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Teachers guide

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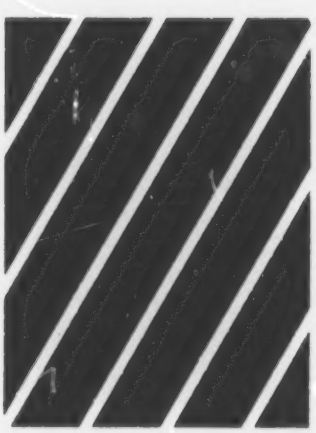

SOIL CONSERVATION

A guide to classroom and field activities for middle secondary students

Teachers guide

A joint project of the Department of Agriculture and the Education Department, Tasmania 1983

Foreword

Ours is a hard and harsh land. We have learned that it is a fragile land too, needing care and skill in its management. The Teacher's Guide and accompanying materials are published with the hope that those who will have the task of managing our soils and land in future generations, will be better equipped to do so. A great number of people have shared this goal with me. In particular my thanks must go to

L.R.Richley, Soil Conservation Officer,
Department of Agriculture, Hobart;
and the following officers of the Education Department:
R.F.B. Pallet, Supervisor of Science;
L.Scott, of the Curriculum Centre.

In addition I would like to extend my thanks to the teachers who trialled the draft material in Bridgewater High School and in Ouse, Dover, Yolla, Oatlands and Lilydale District High schools.

Bruce D.Tivendale, Hobart
formerly of Department of Agriculture

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Introduction

'The nation that destroys its soil destroys itself'.
(F.D.Roosevelt; letter to the Governors [U.S.] urging uniform soil conservation laws.)

This is a short course on 'soil conservation' rather than on 'soils' as such.
Of course some understanding of soil is a necessary pre-requisite to the conservation of soil – and where such information is needed it has been included. But the emphasis is on the importance of soil and the need and means to conserve it, not on a mere knowledge of soil for its own sake.

Soil is a natural resource of inestimable value. It is classified as a renewable resource, but because it may take from a few hundred years to a few thousand years to be renewed*, it is more accurately termed an exhaustible resource.

The major agent of erosion in Tasmania is water, not wind. For this reason the exercises in this Unit will focus on water erosion.

The constraining principle behind student exercises is that soil erosion is generally to be found outside. Obviously! Beakers, test tubes and lumps of soil bear little relationship, in the pupil's mind, to soil washing off a hillside. To be effective, environmental education programs should provide frequent opportunities for students to go out into the environment. It is essential that students have the chance to visit particular locations and to perhaps hear the landowner's comments on soil erosion and soil management problems: students need to understand that it is most often the careless or ill-planned activities of man which are the root cause of erosion. Only through such visits will students develop a true understanding of the issues at stake. Therefore, teachers are urged to use the outdoors as the learning laboratory as often as is practicable. Alternative indoor activities are included when this is inconvenient.

There is a definite sequence to the activities, but individual activities can be attempted in a number of ways and teachers are encouraged to adapt whatever approach best suits the needs and capabilities of their students. Some exercises may be better split up so that different groups do different parts of the exercise; others may be more conveniently handled simply as demonstrations to the whole class; and yet again some exercises could be undertaken by students working in small groups or in pairs. In certain situations students may benefit most if the exercises are built into a residential school camp or field trip. This is all left to the discretion of the teacher.

The exercises deliberately avoid precise method and measurement and mathematical analysis: how often do pupils get lost in these activities and completely miss the object lesson?

Using the Kit
The activities and slide-tape presentations that comprise this short course have been carefully sequenced to develop the main ideas and understandings. Teachers are therefore advised to sequence the activities and show the slide presentations in the order followed in the student booklet.

Stencil masters of the Student Manual have been provided so that teachers can run off as many copies as they require. A sample copy of the complete Student Manual is included: this can be used as a duplicating master if any of the stencil masters are mislaid. It is recommended that the sample copy be kept with the kit at all times.

* One estimate claims that under virgin soil conditions the formation of 25mm of topsoil would take 300 years. However, under agricultural conditions this would be reduced to approximately 30 years – i.e. a little less than 1mm per year.

The slide tape sets have been electronically synchronised to allow automatic presentation, using the appropriate equipment. The slide tape sets may also be presented manually using the cue scripts included in the Teachers Guide.

Using the Teachers Guide
This Guide provides teachers with explanatory background information for each of the activities listed in the Student Manual.

The importance of soil

A slide tape set.

The slide tape commentary is reproduced below to provide teachers with the information they may need to help students successfully complete the questions listed in the student booklet. The commentary may also be used as a cue script for manually advancing the slides.

1. Title Slide 'The Importance of Soil'.

2. Tasmania is a State of great natural wealth – with its rich agricultural land, abundant forests and unequalled scenic beauty – it's little wonder that the early settlers looked upon our island state as the 'Promised Land'.

3. The promise of prosperity drew these early settlers across the state to till and farm its rich soil.

4. Forests gave way to the plough, yielding hundreds of thousands of hectares of crop and pasture land.

5. Good soil and ample water formed the basis of the infant colony's economy which today still depends heavily on farming and forestry.

6. Today Tasmania's farmlands produce a variety of crops ranging from fruit and vegetables . . . . .

7. to specialist crops such as poppies.

8. Cattle graze our lush pastures, providing meat and dairy products

9. and our sheep produce meat and some of Australia's finest wool.

10. Forests also contribute substantially to the wealth of our state. Native hardwood forests grow wood for the production of paper, sawn timber and woodchips for export.

11. The basis for all plant growth is the soil.

12. Vegetables, fruit and grain all come directly to us from plants that grow IN the soil.

13. Other products such as milk, meat, wool and leather come from animals whose food chain is linked to the soil through the food they eat.

14. However, it would be a mistake to think that the soil's only service to mankind is the production of food and fibre.

15. Take recreation. You may not have thought of it, but the last time you played football, hockey, netball or tennis you were playing by courtesy of soil. All these sports depend on the soil to provide a stable base for playing fields.

16. Similarly our native bush gives us the opportunity for fun and relaxation. This
+ natural beauty is the result of climate, landform AND soil.
17.

18. Our cities and towns depend on soil for stable foundations for their buildings.
+
19.

20. Even the roads which service these cities and towns owe their existence to soil.

21. Heavy earthmoving equipment utilises soil as an economical and quick means of reshaping the land's surface.

22. The construction industry uses many building materials which come directly from the soil. Clay, for example, can be processed into familiar objects such as bricks, roofing tiles, stoneware and sewer pipes.

23. Sand is another useful soil component finding uses in the glass, electronic and construction industries.

24. Rubbish – an undesirable and unfortunately necessary part of our lives.

25. This sanitary landfill uses layers of soil to accommodate large quantities of solid waste.

26. When the area is finally filled to capacity, topsoil is spread and grass is grown. This large, level area is then suitable for playing fields and other recreational uses.

27. Much of the soil's wealth lies underground in the form of mineral ores. Mining forms an important part of this state's economy -- both as an employer of manpower and as a valuable export dollar earner.

28. If the topsoil has been carefully stock-piled before mining begins it can be returned to the area when the operation is completed. This allows trees and shrubs to grow back over the site – restoring natural beauty.

29. We've seen over the last few minutes how soil serves us in agriculture, forestry, mining, construction and recreation.

30. In future audio visuals entitled 'The Abuse of Soil' and 'Soil Management' we'll look at how soil is being destroyed by improper use and at how it can be preserved for generations to come.

END.

Slide Credits

Lands Department 16
Z. W. Karpiniec 17
Tasmanian Film Corportation 10, 15, 18

Does it matter if soil erodes?

On completing the activity students will observe marked differences in plant growth and therefore in the fertility of the two soils tested. Soil fertility has chemical, physical and biological aspects:

Chemical fertility refers to the ability of the soil to provide particular nutrient elements for plant growth. Related to this is the pH of the soil; availability of elements to plants varies with pH.

Physical fertility is determined by the TEXTURE and STRUCTURE of the soil:

Soil texture is determined by the proportion of sand (2-0.02 mm diameter), silt (0.02 – 0.002 mm diameter) and clay (less than 0.002 mm diameter) in a soil.

Soil structure is the size, shape and arrangement of aggregates formed from these primary soil particles.

Texture is a relatively fixed characteristic of a soil; structure is determined by management, organic matter content and the nature of the clay. A physically good soil allows ease of root penetration and seedling emergence, holds adequate water and facilitates the diffusion of oxygen and carbon dioxide.

A crumbly (well-structured) soil:

1. absorbs water faster than a cloddy (poorly structured) soil and holds more;
2. allows the drainage of excess water;
3. enables plant roots to grow easily through the soil in search of water and nutrients;
4. allows ample supplies of oxygen to percolate down to those roots from the air; and
5. is easier to work – a saving in time and fuel (money!).

Biological fertility refers to the presence or absence of flora and fauna, helpful or harmful to plants in the soil.

Plants usually grow better in topsoil than in subsoil. The topsoil:
- holds more available nutrients and organic matter;
- has better structure; and
- greater numbers of useful flora and fauna.

Soil erosion creates on-site and off-site problems.

On site: loss of productivity (due to the removal of the finer soil particles and associated plant nutrients and organic matter);
increased runoff resulting in reduced water availability for crops and pasture;
deposition of sediment in farm dams, streams and irrigation channels.

Off-site: siltation of public water storages;
deposition of sediment on roads, railways and other public utilities.

What can a raindrop do?

Erosion, in large measure, follows disturbance of the natural landscape. When there is excessive burning, grazing, forest cutting or cultivation, the soil is left unprotected. Water can then remove soil faster than it can be formed. However, water erosion is not just the washing away of soil by flowing water.

Raindrops falling on unprotected soil break down small clods and crumbs; subsequent drops splash this material into the air. This is SPLASH EROSION and it is the first and most important stage in the erosion process.

Rain has a much greater velocity than surface flow and many times the kinetic energy.

On steep slopes, soil particles propelled by raindrops, fall downhill resulting in considerable soil movement, without soil being carried away by water. That is, there can be considerable soil movement and damage, even when surface runoff is not sufficient to transport soil in suspension.

The splash process produces four different types of erosional damage:

1. BURYING OF TOPSOIL – topsoil scalped from the crest of a slope piles up at the bottom of the slope and is later covered by subsoil. This is a long-time development, not the result of a single storm.
2. SURFACE SEALING – a proportion of the finer particles, broken off from larger crumbs and splashed up, fill pore spaces in the surface and seal them. This causes a number of ill effects:
   (i) an increase in runoff; and with the surface drying to a hard crust;
   (ii) soil droughtiness;
   (iii) interference with soil aeration;
   (iv) prevention of seedling emergence.
3. DETERIORATION OF SOIL STRUCTURE – the raindrop impact breaks down many aggregates, also allowing organic matter to disperse and be lost.
4. LOSS OF NUTRIENTS -- clays, which provide most of the chemical nutrition, disperse and are lost.

The basic method of erosion control is to maintain a protective cover of plants. This sounds simple enough, but in practice it is complicated by the fact that the cover must usually be productive as well as protective. Any kind of crop cover reduces soil movement. Soil erosion will be more severe on cultivated fields during early spring when the ground is bare, before crops get started.

As well as splash erosion, there are four other forms of erosion:

1. SHEET EROSION is the more or less uniform removal of soil over the whole surface by water or wind. No obvious channels develop.

2. RILL EROSION results from the development of small channels. The numerous channels are usually brushed over by normal field operations, so the soil loss does not remain evident.

3. GULLY EROSION is the most conspicuous form of water erosion. It can be spectacular but is destructive and cancerous to the land. Once begun, gullies tend to enlarge. They may range in depth from 0,3m to 30m.

4. TUNNEL EROSION is the formation of underground channels through the removal of (dispersible) subsoil by seepage water. Tunnel erosion is a most insidious form of erosion because of the amount of deterioration which occurs before there is any visible sign of damage.

Section Three - FACTORS THAT AFFECT SOIL EROSION

What effect does slope have on soil erosion?

The slope of land controls the velocity of runoff water, which determines the erosive power of that water. Thus, steep slopes erode more rapidly than relatively flat areas.

A slope of one in ten is dangerous for cultivation whatever precautions are taken. With still steeper slopes it may be inadvisable to clear the land at all – the limit here depends on the particular climate and management and soil type.

Is rainfall intensity important?

Large amounts of rainfall in a short period of time can cause severe erosion. The same amount of rainfall over a longer period may not cause any erosion. Light, misty rain, with small drops, gently falling has little kinetic energy to detach soil particles. Light rain may be completely absorbed into the soil as it falls, with little likelihood of runoff and transport of soil.

How fast do soils absorb water?
Do soils differ in their behaviour in water?

The two exercises will be discussed jointly. A soil with low aggregate stability (that is, with a tendency to break down or disperse in water) is more likely to be erodible; a soil more absorptive of rainfall is less likely to be erodible.

Mathematically:

$$\text{soil erodibility (E)} \quad \propto \quad \frac{\text{the soil's tendency to break down or disperse in water (D)}}{\text{the soil's capacity for infiltration (I)}}$$

For a given amount of rain the rate of water intake determines the amount of water that runs off. The more water that enters the soil, the less there is to run off. A high infiltration rate is an advantage to the farmer because more water is available for use where it has fallen and at the same time there is less risk of erosion by excessive runoff.

Infiltration rates are determined not only by inherent characteristics of the soil, but by mechanical action which tends to compact the soil. Grazing animals compact the soil – sheep exerting a pressure of 3.5 kg cm^{-2}, especially at a high rate of stocking, are the worst offenders. Heavy machinery and vehicles also cause compaction.

Soil compaction on recreation trails and sites in some parks and forests is a serious problem.

It is considered that the above should be sufficient explanation for students at this stage. However, for those interested, the following is extracted from P.E.V. Charman's 'The Soils of New South Wales – their Characterisation, Classification and Conservation' (1978).

> 'AGGREGATE STABILITY is related to the tendency of soil aggregates to deflocculate or break up into smaller particles. This property, or the lack of it, is a most important factor in the susceptibility of many soils to normal forms of erosion, as aggregation not only affects soil breakdown and dispersion but also controls infiltration to a large extent.

Aggregate stability is a result of both physical and chemical processes. The main properties controlling it chemically are the percentage of exchangeable sodium ions held on the clay particle surfaces, and the degree to which clay particles and organic matter react to produce interparticle bonds. Clay type is also of considerable importance. Physically, the pressures created by shrinking/swelling, freezing/thawing, and wetting/drying are all important in the aggregation process. Combinations of different sizes of particles lend themselves to the formation of aggregates more readily than homogeneous soils.

INFILTRATION is defined as the movement of water into soil. The infiltration rate of a soil is variable and different from hydraulic conductivity which is the lowest rate at which water is absorbed by soil. Initially, water infiltrates at a rate well in excess of the saturated hydraulic conductivity. The rate then rapidly declines until it reaches this value. The saturated hydraulic conductivity of a soil is therefore a meaningful measure of infiltration because its variability is small, and, more importantly, it is a property which can be inferred from other soil characteristics.

The saturated hydraulic conductivity of soils is directly related to the size and distribution of pores in them. The larger the particle and/or aggregate size, the larger is the pore size and hydraulic conductivity. Thus the hydraulic conductivity of soils, in terms of distinguishable field characteristics, is dependent on soil aggregation and texture.

TEXTURE is an expression of the proportions of different particle sizes in soils, and as the texture ranges from sand to clay, the hydraulic conductivity decreases. Soil structure is an expression of the arrangement of soil particles into aggregates which are always much larger than the size of the comprising particles. Consequently, the pore sizes between aggregates will always be larger than those between individual soil particles. It is obvious, therefore, that texture and structure interact in such a way that within each of the texture classes, there will be a range of permeabilities dependent on the degree of structural development.

Thus the soil factors that need to be assessed with regard to erodibility are as follows:

1. Soil structure.
2. Soil texture.
3. Soil dispersibility.

The inter-relation of soil structure, texture and erodibility is complex.'

Does grass cover affect soil loss ?

This exercise illustrates one of the most fundamental principles of soil and water conservation: the protection grass gives soil against the pounding of raindrops and the movement of running water.

The impact of millions of individual raindrops has a tremendous effect on the soil. Splash erosion is the first and most important stage in the erosion process. There is only one way to control splash erosion – by protecting the soil against the impact of raindrops. Grass or

other dense cover stops the beating action of rain, allowing water to soak in. Vegetation also serves to reduce runoff by using water for its own growth and consolidating soil by a network of roots.

Also, the grass roots open up channels to let water into the soil, and as the water runs off, the stems of grass slow it down so that it does not have enough speed to transport soil particles.

You will find that the water will rush off the bare slope, taking soil with it. The flow will soon stop. In contrast, the water that flows from the grass will be reasonably clear and it will take longer for the flow to start and it will continue longer. Also not as much water will reach the bottom.

Section Four - THE EFFECTS OF SOIL EROSION

The abuse of soil

A slide/tape set

1. Title Slide 'The Abuse of Soil'.

2. We've seen in the previous A/V titled 'The Importance of Soil' how soil benefits us in many ways. In this program we will look at some of the causes and effects of soil erosion.

3. Erosion, or the wearing away of valuable top-soil by wind and water, is the chief culprit in the destruction of soil. It's a national problem that's undermining the wealth of Australia and crippling our rural productivity.

4. Erosion can be grouped into six main categories: 1. splash erosion; 2. sheet erosion; 3. rill erosion; 4. gully erosion; 5. tunnel erosion; 6. mass movement. Let's look at these individually.

5. The most common form of soil damage occurs when raindrops strike bare, unprotected earth. This is known as SPLASH EROSION and we can see here how a single raindrop can strike the earth with such force that it scatters soil particles many centimetres away. Imagine this happening thousands of billions of times over and you can see what happens during heavy rains.

6. This field shows an example of SHEET EROSION where a thin layer of soil is washed away by water moving over the entire surface . . . in this example over-grazing by sheep led to the removal of soil-holding vegetation leaving the land vulnerable to erosion.

7. Flowing water on sloping land eventually forms grooves in the surface. This is known as RILL EROSION.

8. Rill and sheet erosion on this hillside have washed away soil which has settled in the creek. Unable to carry the same volume of water, the creek has overflowed and flooded the land.

9. In any landscape there are lines along which water tends to flow naturally. Here the small gutter leading to the dam is cut wider and deeper until the flow of water continues the gully head further up the hill. This process is known as GULLY EROSION.

10. Gully erosion can become so serious that land is impossible to farm. Gullies drain areas, robbing soil of moisture and goodness. They are an obvious danger to stock and can make movement from one part of the farm to another very difficult.

11. Water flowing over the ground will soak in where there are small holes, old stumps or rabbit holes. Eventually the sub-soil washes out leaving underground tunnels. This is known as TUNNEL EROSION.

12. On steep land that has been cleared of trees, large volumes of soil may fall and slip down-hill under the force of gravity. This is known as the MASS MOVEMENT of soil.

13. The lean on this fence is the result of soil creeping down-hill. Eventually it will collapse completely facing the owner with considerable expense in replacement.

14. And what is man doing to prevent soil erosion?

15. The truth is that for a variety of reasons, many of them economic or social, we're abusing the soil and increasing the likelihood of its destruction through soil erosion.

16. A prime example of this is in our forests. Here large numbers of trees are cleared from the slopes of hills, contributing to erosion.

17. Even the hauling of logs out of the forest creates channels, which, with continued
+ traffic become deeper and deeper and so weaken the soil structure, thus a valuable
18. resource area is rendered of no use to anyone.

19. Roads are a necessary part of forest operations. This road has caused the soil to become unstable and slide into the river. As well as making the road impassable, the land becomes unprotected and non productive and the river loaded with sediment.

20. A love of the outdoors may have harmful consequences for the soil. You can see here how much deeper this bare track has become compared to the normal soil surface. Soon this track will become waterlogged, causing bushwalkers to start another trail — so repeating the process.

21. Off-road vehicles are a popular source of recreation. Unlike people, they are not confined to tracks and indiscriminately wreak their destruction over a wide area. These heavy vehicles kill plant cover and compact the soil. Water soon accumulates in these ditches and erodes the soil.

22. Poorly located and constructed roads form creeks in heavy rain. This road has no proper drainage which is causing soil to be scoured off its surface, and deposited in a nearby water storage.

23. Trail bikes beating up and down this hill have killed the grass and shrubs and caused erosion.

24. Beaches and sand dunes are easily damaged. In the natural state, the sand is held in place by highly specialised plants. People trampling over this dune have crushed the vegetation, exposing the sand to wind erosion.

25. Vehicles also can cut down and destroy vegetative protection on beaches in a very short time. Here, large amounts of sand have been blown away from between the clumps of vegetation.

26. The dunes, in this unstable condition, creep back, often smothering otherwise useful land.

27. Soil stability is important in urban areas. This steep house-block is eroding and, without a plant cover to protect the soil, it will continue to wash away. As more topsoil is lost, plants are less able to grow. Erosion could endanger the foundations of any house built on this site.

28. This house, near Launceston, is in an area of land that slipped. The State Government became involved in a huge compensation payment to the owners. A proper understanding of the soil would have indicated that the land was unstable and unsuitable for housing construction.

29. Roadmaking can expose soil embankments and steep soil faces are easily eroded, filling roadside drains and washing soil over the road.

30. In some cases the road may be undermined causing it to collapse.

31. Our countryside is littered with quarries, large and small, which, having served their purpose are left to erode. Land disturbed by earth moving is highly erodible because covering vegetation and topsoil have been removed Little attempt has been made here to restore land to a stable condition.

32, Hydraulic mining uses water pumped down a sluice to wash metal ore free of soil.
33, The suspension of remaining soil and water, known as a slurry, makes its way into
34. creeks and rivers causing them to fill up with residual sediment. The subsoil remaining after the mining operation has ceased provides a poor basis for future plant growth. Careless mining operations like this pollute rivers and mar the landscape.

35. We have seen how soil erosion degrades the land – both rural and urban. But the problem doesn't just stop there. Soil that is lost from the land, be it towns, farms or forests, has to go somewhere. A build-up of soil in a gutter looks harmless – but where does it end up?

36. An inspection of a waterway, such as this rivulet in Hobart shows how much soil can be lost from our cities. Multiply this by all the other waterways in Australia and the loss of this precious resource is in staggering quantities.

37. This dam was built to supply domestic water to the township of Sorell, in the south-east of the state. Erosion from the dam catchment area caused sedimentation which has greatly reduced the dam's capacity. The water is now so shallow that rushes are growing in the sediment.

38. Much sediment ends up being deposited in rivers, resulting in water levels reaching greater heights which, in turn, cause more frequent flooding and damage to life and property.

39. The implications of sedimentation are enormous. The bridge in this picture had to be raised in order to compensate for the difference in water levels and the water supply for a nearby town was rendered almost unusable through excess sediment. The level of sediment eventually reached a point where fish numbers started to die off.

40. Eventually most of this lost soil makes its way to the sea and is gone forever. Notice the discolouration of the water as it enters the sea.

41. Whether we live in the country or the city, soil is important to us.

42. Our abuse of the soil has been at a heavy cost to all mankind. But this need not continue – we know enough about our soil and land management to control erosion that is already occurring and to prevent erosion in the future.

43. In the third and last program in this series titled 'Soil Management', we will look at proper land management through an understanding of the soil.

Slide Credits

Lands Department 6, 21, 22, 24, 25, 30, 32, 33
Rivers and Water Supply Commission . 8, 38, 39, 40
Tasmanian Conservation Trust 17, 23

Section Five - PUTTING A STOP TO SOIL LOSS

What does contouring do?

Contour Farming is one of the easiest and most widely accepted conservation practices around the world. It involves the use of implements on the contour. When a farmer works his land on the contour, he disregards the usual straight field boundaries and follows curved lines whenever necessary to stay on the contour. It can take several forms:

a) Contour furrows – a series of shallow furrows are cut along the contour at a distance of 6 – 10 metres from one another. Though they may be only 10 cm deep, they can hold up rain water long enough for it to soak in. The benefits are more water (and more feed) on the hill and less runoff (and erosion) lower down.

b) Chisel seeding (sod-seeding, minimum tillage) – seed and fertiliser are sown directly into small contour furrows, ploughed into otherwise uncultivated ground. The extra water trapped by the furrows aids germination.

c) Ploughing and planting on the contour – crops on sloping ground are sown on the contour, using permanent sighter pegs.

Greater infiltration has several beneficial results:

Floods are less severe.

Water seeps to streams slowly and over a longer period (cleaner streams).

Water is stored in the soil for plants to use.

Does mulch help ?

Yes – mulching is very important for minimising the effect of raindrops on soil (i.e. splash erosion, see Section Two, Activity 1).

There is only one way to control splash erosion – by protecting soil aggregates from the direct impact of raindrops. This protection can be provided by making fuller use of growing crops (see Section Three, Activity 5) and better use of crop residues (mulches).

Mulches provide the following advantages:

water reaches the soil with negligible velocity;

aggregates are not broken down;

soil pores remain open;

infiltration continues; and

erosion is minimised.

Stubble mulching is a method of soil tillage which cuts crop roots but leaves crop residues on top of the soil, thus providing a mulch over the soil.

As this mulch decays, it provides organic matter and nutrients to the soil.

Mulches also reduce evaporation by shielding the soil from the wind and the direct rays of the sun.

Soil Management

A slide/tape set

1. Title Slide 'Soil Management'.

2. In the previous two audio visuals we've discussed why soil is important to us and the ways in which it can be damaged through erosion. This is the last program in the series and in it we will look at ways in which the soil can be used without abusing it.

3. Agriculture is one of the cornerstones in the foundation of Australia's economy. In order to provide adequate food for the present, and to ensure the future condition of our farmlands, a proper land management program is needed. Throughout the farming community there is a growing awareness of the need to conserve soil.

4. This bank, constructed from earth, prevents the uncontrolled flow of water downhill and directs it into safe places that will not erode. Water can then be led to a farm dam, so conserving water as well as soil.

5. This grassed waterway carries runoff without eroding the land. The grass prevents the waterway itself being eroded.

6. Some gullies can be sc badly eroded that they can only be controlled by concrete structures such as this spillway. This is a costly measure and is used only in extreme cases of soil erosion.

7. Sod seeding, or minimum tillage, rather than traditional cultivation, reduces erosion. Seeds and fertiliser are applied with a chisel seeder after any weeds present have been killed with a herbicide.

8. Sod seeding prevents the soil being broken up as much as normal ploughing does and this results in less erosion. Savings on time, fuel and labour make it a cost effective operation, too.

9. By ploughing with the contour of the slope, rather than up and down, this farmer has minimised the amount of soil lost through erosion.

10. The same principle is applied in this orchard.

11. + 12. Sand dunes are difficult places to grow plants. In some areas where the original vegetation has been destroyed, Marram Grass has been used to hold eroding sand. The roots of Marram Grass extend widely through the soil binding it together.

13. Sometimes tracks must be blocked off so that people and vehicles can't trample on an area being restored.

14. Pinning boards across bushwalking tracks trap silt and keep them intact for walkers to use.

15. These drop structures, built in a vegetated drain alongside this new highway, will prevent a gully forming. By decreasing the slope over which the water flows, erosion in the drain is reduced.

16. Retaining walls are needed in some urban situations to stop soil sliding downhill. Creepers can be planted in the spaces between the blocks and will eventually grow to cover the entire wall.

17. Growing grass over road embankments helps to beautify an otherwise ugly scar and prevents soil erosion.

18. It's good land management to retain trees on steep slopes and pasture cover on lower slopes. Rainfall infiltrates the soil and is used by these plants leaving very little residue to cause erosion problems.

19. Poor vegetative cover increases the amount of unused water soaking into and flowing over the soil. This results in excessive accumulation of salts, land slip, erosion and sedimentation of streams.

20. The problem can be seen here. Trees high on this hill were chopped down and cleared. The amount and speed of water flowing to the lower slope is too great for the land to cope with and so the soil is eroded.

21. Land will not erode if it is used according to its characteristics of slope, soil type and climate. For example, in this slide, Class 1 land can be intensively cultivated – producing a wide range of crops year after year. This would be impossible in Class 7 land which is suitable for rough grazing or Forestry purposes.

22. What then is our responsibility?

23. We have seen that wherever we live – city or country – we depend on the soil in
+ many ways.
24.

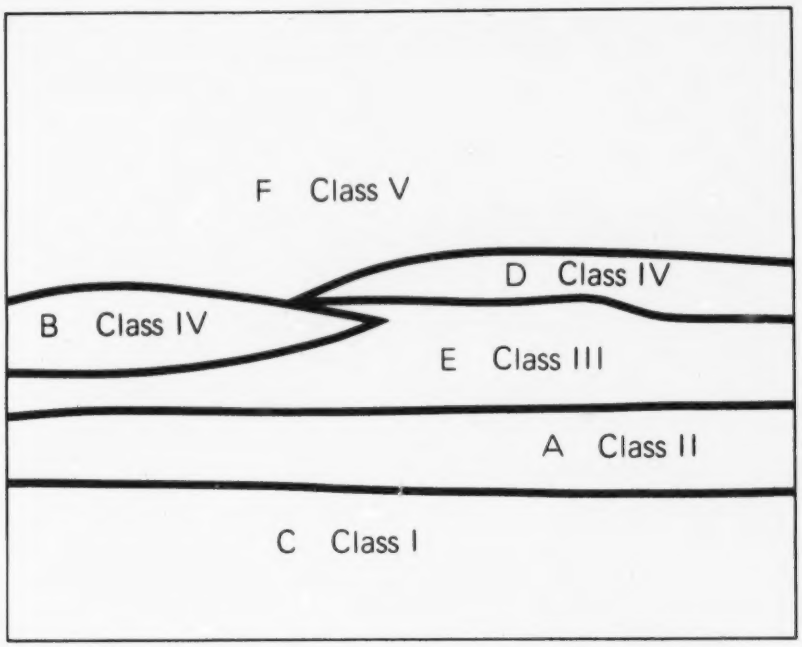
25. But strained and worn our by misuse, and depleted by erosion, the soil loses its usefulness.

26. Whether you live on a farm or in the city, soil conservation works in our favour.

27. There are numerous ways in which we can protect our soil; the common denominator in all of them is you.

Slide Credits

National Parks and Wildlife Service ... 14
Lands Department 11, 12, 13



Answer to student question No. VI (page 23 of Student Manual).

Taking a tour to see your land

Soil erosion is not hard to find – you will find it wherever man uses the soil:

on farms, producing food and fibre

in forests

in parks and other recreation areas

on housing, commercial and industrial sites

in gardens

on and near roads

in quarries, mines and dumps.

Developing a day tour will depend on your particular geographical location. This being so, only general guidelines can be offered.

Where erosion is found to occur, there are some basic questions which can be asked.

1. **What are the principal causes?**
   Which of the factors which dispose land to erode – soil, vegetative cover, slope, rainfall – have been neglected? (e.g. OVERCLEARING of steep slopes; highly DISPERSIBLE soils.)

   A simple DISPERSIBILITY test: take a crumb of air-dry soil about 5 mm across from that part of the soil profile which is anticipated to be the most dispersible, usually the lower part of the B horizon. The crumb is placed into distilled water in a transparent phial and allowed to stand. After 10 minutes the soil crumb is observed. The soil will fall broadly into:

   - no dispersion (water remains clear throughout);
   - a halo of dispersed clay around the soil crumb;
   - considerable clouding, although about 2/3 of the particles remain intact;
   - complete dispersion (sand grains in a cloud of clay).

2. **What are the on-site and off-site effects?**
   (e.g. pollution of a town water supply; blocked road culvert.)

   The problem may not look particularly serious; how would you determine the long-term effects of this erosion?
   Is it possible and desirable to prevent all erosion?
   If not, how do we decide that erosion is serious enough for control to be attempted?

3. **Could this land be managed to control erosion?**
   Has control been attempted?
   What measures in particular?
   How successful have they been?
   What other control measures could be attempted?
   Are these solutions physically possible, economically feasible?
   Who should pay the costs of control?

4. **How could erosion have been avoided?**
   Was it possible to predict that this erosion would occur?
   Could this land be put to other uses which would not cause erosion? If so, what uses?

5. **Is the owner/manager of this land concerned to control this erosion and prevent further erosion?**
(You may have to interview him!) If not, why? If this land is under State control, which is the Government Department concerned? (Contact this Department and ask for their view of the problem.)

6. **Should the State have control over activities on private land which cause soil erosion?**
Erosion on privately owned land may affect us all (e.g. damage to public facilities). Should the State be able to force private land owners to take action to control erosion?

Include in the tour, stops where conservation practices are being successfully employed.

Three specific activities may be mentioned:

1. ROADSIDE EROSION SURVEYS – students can be issued with a route map of the tour; as they travel the route, the map could be marked with coloured pencils or different shadings depending on the degree of erosion at the roadside:

   green – no erosion
   yellow – slight erosion
   red – severe erosion

2. Identify an AREA OF SERIOUS SOIL EROSION in your community – discuss what could be done about it and, with appropriate permission and supervision, allow students to apply a soil conservation measure (e.g. planting a hill with tree seedlings).

3. Improve the SCHOOL GROUNDS – with your students, look over the school grounds for signs of soil erosion or compaction. Ask students to suggest and list ways they might control the erosion or avoid further soil compaction. Possible solutions might include:

   placing signs;

   planting the area;

   constructing a path of bark or wood chips around the area.

Students can observe the results of their efforts to solve the problem.

Which methods were successful? Why?

Why did some methods not work?

When there are sufficient numbers of teachers, officers of the Soil Conservation Unit of the Department of Agriculture will be available to take them on a tour to look at soil conservation and erosion. This tour could be the basis for the teacher's own class tour.

A summary of non-consumable items needed for the course

Item	No. Required (Section/Exercise)
Beaker, 500 cm^3	2(3/1), 2(3/2), 2(3/4)
Blotting paper, white, 35cm x 35cm	2(5/1), 2(5/2)
Board, 10cm x 2cm x 1m, painted white with tin shield	1(2/1), 2(2/1)
Bucket	1(3/3), 1(3/5)
Dowel rod, 25cm long	1(3/3)
Flower pot, 10 – 15cm diameter	4(1/3)
Garden hoe	1(5/1), 1(5/2)
Hammer	1(2/1), 1(3/3)
Hardboard, 35cm x 35cm	1(2/1)
Hose, with sprinkler attachment	1(5/1), 1(5/2)
Litre measuring container	1(3/3), 1(3/5)
Metal jar lid, 5cm x 2cm	1(2/1)
Ruler	1(1/3), 1(3/3)
Saucer	4(1/3)
Stream tray; or tray 40cm x 30cm x 10cm, made watertight by sealing with plastic, V-notch at one end.	2(3/1), 2(3/2), 2(5/1), 2(5/2)
Tin can, both ends removed, 10–15cm diameter	4(3/3)
Watch, or clock, with second hand	1(3/3), 1(3/5), 1(5/1)
Watering can with a sprinkler attachment	1(2/1), 1(3/1), 1(3/2) 1(5/1), 1(5/2)
Wooden block, 2cm x 2cm x 30cm	2(2/1), 6(3/1), 2(3/2), 6(5/1), 6(5/2)

Further Resources

Audio Visual : Tasmania Media Centre

The following resources are available for loan to Tasmanian schools and colleges:

K579	Origins of the Earth – Soils I and 2
J2507	The Story of Soil
	Problems of Conservation : Soil
	(to be accessioned late 1983)

Books and Articles

The books and articles listed below are, in the main, taken from the popular and semi-technical literature. Most would be suitable as references for students. Except for a few entries, only items with local or national relevance have been included. There is a vast amount of literature available on soil conservation in other parts of the world.

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*Contact the Soil Conservation Officer, Department of Agriculture, Hobart, for copies of this article.

SOIL CONSERVATION

A guide to classroom and field activities for middle secondary students

Student manual

A joint project of the Department of *A*griculture and the Education Department, Tasmania 1983

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Section One - THE IMPORTANCE OF SOIL

Introduction

Soil – to many people it is just dirt, something that has to be washed from hands and clothes, cleaned out of our homes and from our cars.

But think of this for a moment: the cereal you had for breakfast this morning, where did it really come from?

CEREAL from a PACKAGE from a SUPERMARKET from a FACTORY.

In the factory the cereal was produced and packaged. Consider the packaging first:

package → cardboard → papermill → trees → forest → SOIL

Now the cereal:

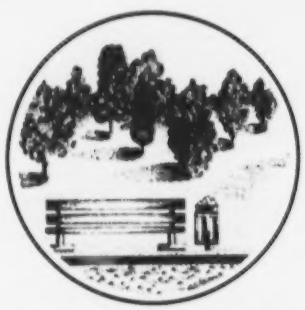
cereal → wheat (or corn or rice) → farm → SOIL

What you ate this morning and what it was packaged in both came from the soil.

In the same way, you could trace many of the everyday items of life back to the soil. Food, clothing, building materials, paper and pencils – these and many other things come to us from the soil.

Soil has other uses apart from being just a place to grow plants. Most outdoor recreations and sports – cricket, football, hockey, bushwalking and so on – take place on soil. Urban development – houses, shops, roads, footpaths and services of power, water and sewage – has soil as its foundation.

SOIL the essential foundation of agriculture and forestry – important for growing food for man and animals, and wood with its many uses.



SOIL for recreation – playing fields, parks and other outdoor pursuits.

SOIL supporting our cities and towns – shops, houses and streets.

SOIL in mining – as a source of clay and minerals.[1]

BEST COPY AVAILABLE

Soil erosion, the movement and loss of soil by wind and water, is a world-wide problem of enormous size. A glance into history, ancient or modern, indicates that nations and civilisations have come into power and prominence, or have gone into decay, depending on how they have protected or maltreated their natural resources, especially soil and water.

An historic example of the effects of man's abuse of the soil is all too plainly visible in North Africa. North Africa was the fertile granary of the Roman Empire. Now it is largely a desert or near-desert.

Each year soil erosion is forcing the abandonment of millions of acres of cropland in Asia, the Middle East, North Africa and Central America.

Soil erosion not only results in a loss of soil but also impairs irrigation systems. This is illustrated in the Mangla irrigation reservoir, recently built in the foothills of the Himalayas in West Pakistan as part of the Indus River irrigation system. Six-hundred million dollars were invested in the construction of the reservoir. It seemed to be money well spent because engineers calculated that the reservoir would last at least one hundred years. However, there has been a rapid growth of population in the area and vegetation has been cleared from the watershed area. This denuding has led to massive soil erosion in the watershed area. So much soil has already been washed down to the reservoir that it is now expected to be completely filled with silt within fifty years.[2]

Tasmania and Australia have problems too: we have a sad record of soil loss and soil degradation which is undermining our prosperity and our way of life.

A recent national study by State and Federal Governments showed that '... just OVER HALF the area in agricultural or pastoral use requires treatment for land degradation if its productivity is to be maintained. At June, 1975, these necessary works were estimated to cost $675 million.'[3]

In other words more than half of the total land used for agricultural and pastoral purposes needs some form of soil conservation.

SOIL EROSION · IT COSTS THE EARTH

1. In other situations the soil *overlies* the minerals being sought by man.
2. Lester R.Brown,*(Human Food Production as a Process in the Biosphere)*, Biosphere, W.H. Freeman and Co., San Francisco, 1970.
3. Commonwealth and State Governments Collaborative Soil Conservation Study, *(A Basis for Soil Conservation Policy in Australia)*, 1975-77, Rep. 1.

Dirt·Who needs it?

Well, who does need it?

Do you?

Is it true that whole nations have decayed and collapsed through misuse of land resources?

STUDENT ACTIVITY

To help answer the above questions attempt the following exercises:

(i) List 10 ways in which soils are important.
For example:
growing lawns, gardens and trees, food for animals, support for houses.

(ii) Think of 25 common items – apples, meat, shoes, rubber, pencils and so on. Now trace their origin.
For example:
shoes – department store – shoe factory – tannery – hides – abattoirs – saleyards – farm – cow – pasture – SOIL!

How many eventually find their way back to the soil?

(iii) This will require some library research.

What happened to the 'granary of the Roman Empire?' Why did the once fertile lands of North Africa become desert?

The importance of soil

A slide/tape set

STUDENT ACTIVITY

Before viewing the slides read over this list of questions – then after viewing the slides write the answers in your notebook.

(i) Name five general areas of human activity that depend on the soil.

(ii) Why are soils important to plant growth?

(iii) How does soil protect community health?

(iv) What building materials in the average home come from the soil?

Does it matter if soil erodes ?

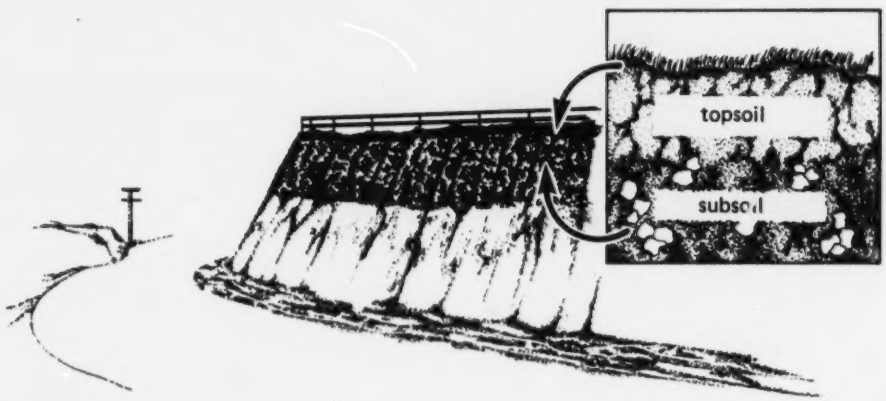
Simply stated, erosion is the movement of soil from one place to another by the action of wind or water.

Well, you might ask, is soil erosion such a serious thing?

Does it really matter that a bit of soil is washed away?

Isn't there always more underneath?

If you have never done so, take a close look at the banks of a road cutting, excavation or other place where soil is exposed in cross-section. It should be clear that the soil lies more or less in horizontal layers. The first layer, which may be as thick as 15 cm is called 'TOPSOIL'. Below this is 'SUBSOIL' differing in colour and texture from the topsoil. [4]



STUDENT ACTIVITY

This experiment will help you to see what effects erosion can have on plant growth and agriculture when the topsoil is washed away.

You will need:

- four containers – preferably flower pots, 10-15 cm diameter (or cut-off milk cartons or tin cans; punch holes in the bottom for drainage);
- a saucer for each container;
- gravel;
- samples of topsoil and subsoil from a garden, and from a forest or good pasture sufficient to fill the containers;
- sixteen seeds – choose corn, bean or similar seeds; and
- a ruler.

What to do:

- Line each container with gravel to allow drainage and fill two with topsoil and two with subsoil. (FINELY CRUSH OR SIEVE THE SOILS FIRST.)
- Plant four seeds in each container, just under the soil surface; soaking the seeds overnight will hasten germination.
- Water the soils and place the containers in a warm, well-lit place.
- Keep the soils moist over the next few weeks.

[4] Where the topsoil continues unchanged past 15 cm, the subsoil can be considered that soil below 30 cm.

Copy this table into your notebook and record the seed growth in each of the four containers:

	TOPSOIL		SUBSOIL	
Date planted				
Date emerged				
Days to germinate				
Number seeds germinated				
Average height: week 1				
week 2				
week 3				
etc.				

OBSERVE the vigour and appearance of the plants in each container.

Answer these questions in your notebook:

(i) What differences in the number of seeds germinated and growth were observed? Does it matter if soil erodes?

(ii) How would production and profit compare between a farm with badly eroded soil and one where soil conservation was practised?

(iii) Can you think of any physical or chemical differences in the soil which account for the different growth rates?

(iv) What problems might arise for the farmer as a result of soil erosion? What could be the consequences for our community?

Section Two - SOIL LOSS - HOW DOES IT START

What can a raindrop do ?

In their natural state most soils exist in small lumps (called 'aggregates' or 'peds') of various sizes from a few millimetres to many centimetres. (The particular shape, size and arrangement of these aggregates is termed the 'structure' of the soil.) It would need a tremendous flow of water across the land to move these aggregates and this hardly ever occurs.

What has to happen to aggregates before soil can be washed away?

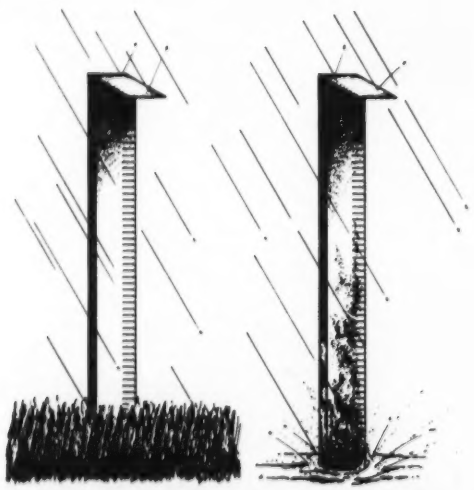
And what causes it to happen?

Let's see what a raindrop can do.

STUDENT ACTIVITY
For outdoor use

You will need:

- two boards, 10 cm wide, 2 cm thick and 1 metre long, painted white:
  - sharpen one end,
  - mark the board with 5 cm intervals,
  - attach tin shields (10 cm wide, 25 cm long) to the top of each board (see diagram);
- watering can or hose fitted with a sprinkler attachment; and
- hammer.



What to do:

- Locate two spots close to each other *with very different amounts of grass cover;* these could be in the school yard or on a nearby farm, for example.
- Drive the boards into each of the two sites to a depth of 15 cm.
- Either leave them there and observe them after the first rain, or simulate rain using a watering can or hose held about 1.5 metres above ground level.
- Allow an equal amount of water to fall, about 30 cm from each board.
- Note the differences in amount and height of soil splashed.

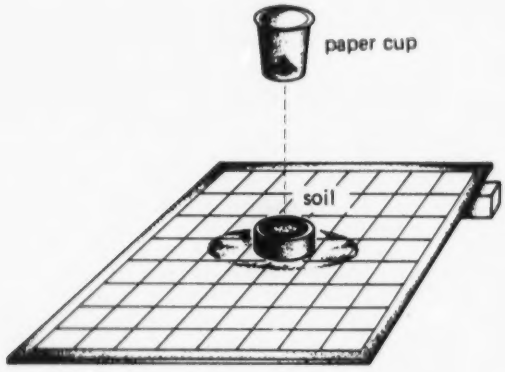
For indoor use

You will need:

- sheet of white blotting paper at least 35 cm square;
- sheet of hardboard (e.g. Masonite) at least as large as the blotter;
- paper cup and cotton wool;
- metal jar lid, 5 cm diameter, 2 cm deep;
- two wooden blocks, about 2 cm x 2 cm x 30 cm;
- medium-textured (loam or clay loam) topsoil; and
- thumb tacks or paper clips.

What to do:

- Pin the blotter to the hardboard.
- Prop up the board 20-25 cm at the higher end.
- Fill the lid with soil and place it in the centre of the paper.
- Punch a 5 mm hole in the bottom of the cup with a sharp pencil, and plug lightly with cotton wool (when half-filled with water the hole should drip 1-2 drops per second).
- Carry the cup in a beaker to a position 30 cm above the soil.
- Remove the beaker and allow water to drip onto the soil (move the cup slightly so that all the soil receives drops). Stop when a good pattern of spashes has formed (before the lid overflows).



Answer these questions in your notebook:

(i) You have been observing 'splash erosion'. What are the two basic stages involved in this process?

(ii) The erosion process can be thought of in three parts:
- the *DETACHMENT* of the soil particles from the soil;
- their *TRANSPORTATION* to another place and
- their *DEPOSITION* in that place.

Which would have a greater impact on the *detachment of soil particles,* a raindrop falling or a drop of water flowing over the surface?

Which, then, is more important in *detachment,* rainstorms or surface flow of water?

(iii) How could raindrop splash be prevented?

Section Three - FACTORS THAT AFFECT SOIL EROSION

Obviously not all land erodes equally. In some areas the soil washes away easily, in others it seems to be more or less stable. Why this difference?

What is it about one piece of land that makes it more erodible than another?

The activities that follow focus on four important factors that affect soil loss . . .

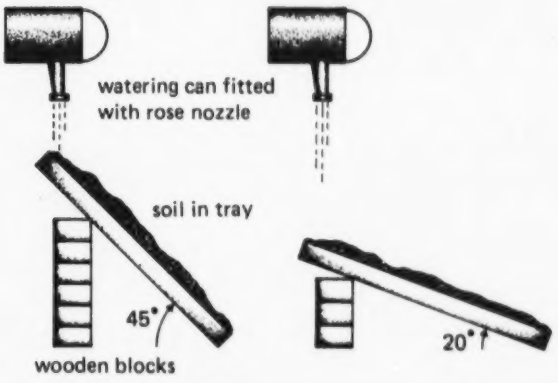
Slope
Rainfall Intensity
Nature of the Soil (how fast it absorbs water, its behaviour in water)
Vegetative Cover

What effect does slope have on soil erosion ?

STUDENT ACTIVITY
This experiment will test the effect of slope on the amount and rate of soil erosion.

You will need:

- two stream tables, or two trays about 40 cm x 30 cm x 10 cm made watertight by sealing with plastic and cut with a V-notch 2-3 cm deep at one end, and fitted with a tin spout to draw run-off water into a beaker;
- two beakers, 500 cm to collect run-off water;
- six wooden blocks about 2 cm x 2 cm x 30 cm;
- enough soil to fill both trays;
- watering can fitted with a sprinkler attachment.



What to do:

- Spread the soil evenly in both trays.
- Use the blocks to raise one end of each of the trays.
- One tray should have a slope of about 20 degrees and the other a slope of about 45 degrees.
- Put the beakers in position to collect the run-off water.
- Pour about one litre of water from the watering can onto the raised end of each tray. Pour the water from the same height.
- Observe what happens; especially noting the amount of soil moved in each case.

Answer the following question in your notebook:

(i) How does the slope of land affect soil erosion?

Is rainfall intensity important ?

STUDENT ACTIVITY

This experiment will test the effect of rainfall intensity on the amount and rate of soil erosion.

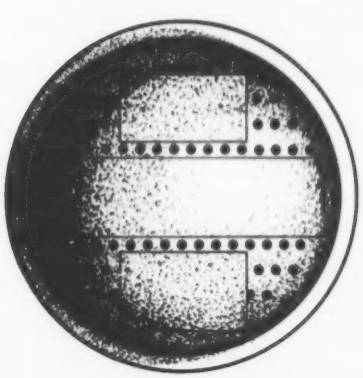
You will need:

- two trays (see Section Three, Activity 1) with soil evenly spread in the trays to a depth of 5 cm;
- two beakers, 500 cm^3, to collect run-off water;
- one watering can fitted with a sprinkler attachment and filled with 2 litres of water; and
- two wooden blocks, 2 cm x 2 cm x 30 cm.

What to do:

- Spread the soil evenly in both trays.
- Use the blocks to raise both of the trays to a slope of about 25 degrees.
- Put the beakers in position to collect the water which runs off.
- Water both trays at the top of the slope and from the same height for the same length of time; modify the nozzle for the second tray. (The modified rose nozzle will give a lower 'rainfall' intensity than the normal nozzle.)

Note how much soil was washed into each beaker and which intensity caused the greater soil movement.



rose modified by placing tape over some of the holes

Answer these questions in your notebook:

(i) What do we mean by rainfall intensity?

(ii) What effect does rainfall intensity have on soil erosion?

(iii) What times of the year is a bare ploughed paddock most likely to erode?

BEST COPY AVAILABLE

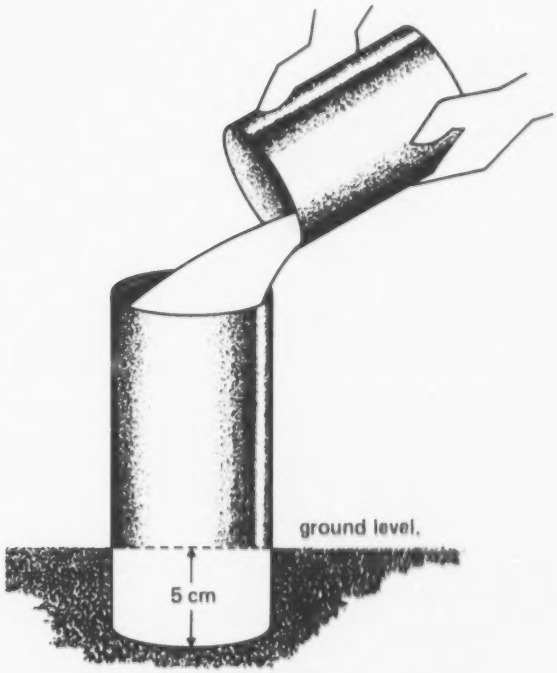
How fast do soils absorb water ?

STUDENT ACTIVITY

This activity focuses on the PERMEABILITY of different soil types, i.e. the speed with which a soil absorbs water.

You will need:

- dowel rod (25 cm long) sharpened at one end, or an ice pick;
- four tin cans (15 cm or 10 cm diameter) – remove both ends including the rim on one end;
- a bucket of water;
- a litre measuring container;
- watch or clock with a second hand;
- hammer; and
- ruler.



What to do:

- Avoiding sandy soil, find a spot in three or four of the following:

  (1) unburned and ungrazed native bush or forest;

  (2) grazed bush or forest where stock have packed the soil;

  (3) a fence line or park where grass has never been ploughed up;

  (4) a pasture that has been grazed heavily and the ground is packed;

  (5) a cultivated field where topsoil is eroded, leaving subsoil exposed.

Around a school, suitable places would be:

(1) an open lawn that is not walked on much;

(2) a park that is heavily trampled;

(3) a spot within a well-developed clump or row of shrubbery;

(4) a garden or flower bed.

- Push the sharpened end of the dowel rod into the ground by exerting as much force as possible with the flat palm of the hand until the threshold of pain is reached (this is NOT a competition to see who is toughest).
- Measure and record the depth the dowel rod can be pushed in at each site. This distance is a measure of the COMPACTNESS of the soil. Or, record the average depth to which an ice pick penetrates the soil when dropped several times from a height of 1.5 metres.
- Twist or hammer the can, sharp edge down, into the soil until it extends below the surface vegetation or litter by 5 cm. Pour one litre of water into the can and immediately measure the level of water.
- Continue to measure and record the level of water for each of the first ten minutes. Thereafter note the drop every five minutes.

Answer these questions in your notebook:

(i) List the soils from most to least compact?
Which soil allows the fastest *infiltration* and which the slowest?

(ii) How does degree of soil compaction affect the infiltration rate?

(iii) Which soils are in less danger of erosion – those with high or low infiltration rates? Why?

(iv) What differences in the soils explain the different infiltration rates?

(v) How is erosion reduced when a soil absorbs more water?

Do soils differ in their behaviour in water ?

STUDENT ACTIVITY

This activity looks at how easily some soils break down in water, i.e. their DISPERSIBILITY. Two or three days before doing this exercise you will need to collect the soil samples described below; allow them to air dry in a warm place.

You will need:

- two beakers, 500 cm ^{3};
- two paper cups
  – puncture the bottom with about nine 3mm diameter holes using a pencil;
- two (not sandy) soil samples
  – one of poor structure from a heavily cultivated paddock or garden bed where the soil is light in colour (i.e. lacking organic matter)
  – one of good structure, from a well-managed field or park where grasses or legumes have been grown, or under an uncultivated fence line;

What to do:

- Place a 2-3 cm diameter fragment of each soil in the punctured paper cups.
- Fill the beaker with water to 2 cm from the top.
- Gently lower the cups with the lumps of soil into the beakers.
- Leave for about 15 minutes, gently raising and lowering the cups from time to time, so that any fine material which becomes detached falls to the bottom of the beaker.
- Watch closely and make notes of what happens.

Answer these questions in your notebook:

(i) Which soil was more stable in water?[6]

(ii) Which soil, then, would be more likely to erode? Why?

Does grass cover affect soil loss ?

STUDENT ACTIVITY

Someone once remarked: 'Agriculture needs a new umbrella'.

This exercise will show you just what he meant, and what sort of umbrella he had in mind.

For outdoor use

You will need:

- litre measuring container;
- bucket of water;
- watch or clock with a second hand;
- two equally sloping sites on or near the school grounds, each about 3 metres in length:
  – one site should be covered with bare soil only, such as the embankments of a road or dam
  – the second site should have good vegetative cover such as grass.

What to do:

- Pour equal amounts of water over the two slopes and observe the results.
- Measure the time to when water first appears at the bottom. What happened to debris (leaves, twigs) on the bare soil?

6. Some soils are very unstable in water and just breakdown into very fine particles, making the water muddy. This is a process known as 'dispersion'.

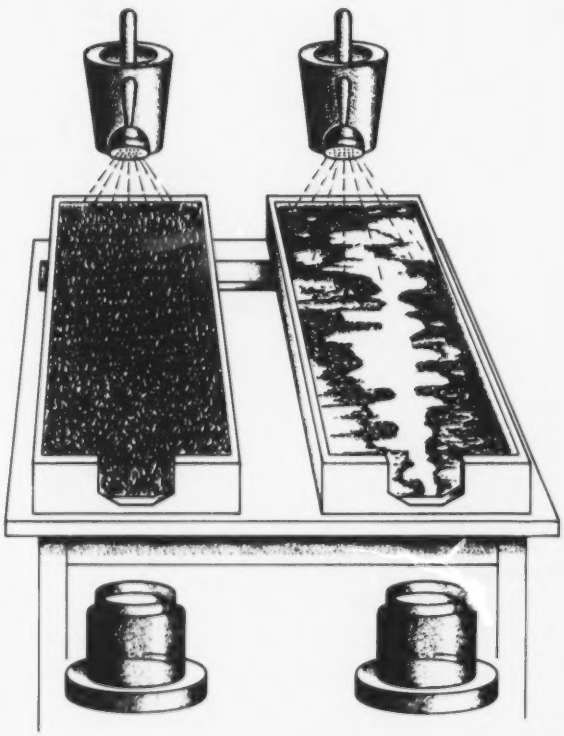
For indoor use

You will need:

- two trays (see Section Three, Activity 1);
- six wooden blocks about 2 cm x 2 cm x 30 cm;
- a piece of turf from a pasture or lawn – trim the grass to 2 cm for ease of handling and fill one tray;
- topsoil only, from the same area as the turf, to fill the other tray;
- a watering can fitted with a sprinkler attachment and holding about 2 litres of water;
- two beakers, 500 cm^3 to collect run-off water.

What to do:

- Prop each tray up with three blocks.
- Pour equal amount of water over the slopes and observe the results. Compare the times taken for water to appear at the bottom, and the amount of soil moved off the trays.



Answer these questions in your notebook:

(i) How does vegetation affect the rate at which water moves downhill? Why is it important to soil conservation that water be slowed down on slopes?

(ii) Which soil held more water?

(iii) How could erosion on sloping land be reduced?

(iv) What farm activities reduce vegetative cover on the land?

Section Four - THE EFFECTS OF SOIL EROSION

Abusing the soil

A slide/tape set

In an earlier slide/tape set we saw that all Tasmanians depend on the soil one way or another. If soil is so important we ought to look after it.

Are we?

And who suffers if we do not?

STUDENT ACTIVITY

Before viewing the slides read over this list of questions – then after viewing the slides write the answers in your notebook.

(i) What is the difference between splash erosion and sheet erosion? Between rill erosion and gully erosion?

(ii) Mass movement occurs only on farmland. True or false? Why?

(iii) What forms of recreation cause land to erode?

(iv) Often water supply catchments are in forested areas. Is this important for normal forestry operation?

(v) Roads are only a source of sediment during their construction. True or false? Why?

(vi) When soil is lost from farmland, is the only cost to the farmer?

(vii) Explain the statement 'soil conservation is water conservation'.

Section Five - PUTTING A STOP TO SOIL LOSS

Introduction

In Section Three we looked at four features of the land and how they affect soil erosion.

These were:

SLOPE OF THE LAND
AMOUNT AND INTENSITY OF RAINFALL
SOIL (ITS PERMEABILITY AND DISPERSIBILITY)[7]
PLANTS GROWING IN THE SOIL

Now, the slope of land and the rainfall in an area are fixed – there is little we can do to change either. If we are going to control erosion we can only do it by the way we manage the soil and plants in the soil.

The importance of plant cover was considered in the activity on page 15. The message there was simple – full coverage by healthy plants protects the soil better than anything else.

We are left to consider the soil. There are ways of improving a soil's stability in water (adding certain chemicals or increasing the organic matter) but we will not consider these here.

Let us turn our attention to what we can do to increase the amount of water entering the soil . . . . .

7. That is, 'how fast water is absorbed' and 'how easily the soil breaks down in water'.

What does contouring do ?

A contour is a line on the land surface joining all points of the same height above sea level.

There are basically three ways land is worked by farm machinery: up and down slopes, around the boundary line regardless of shape, and on the contour.

Which of these is best for the soil?

STUDENT ACTIVITY

This experiment will help you to judge the effectiveness of contour ploughing.

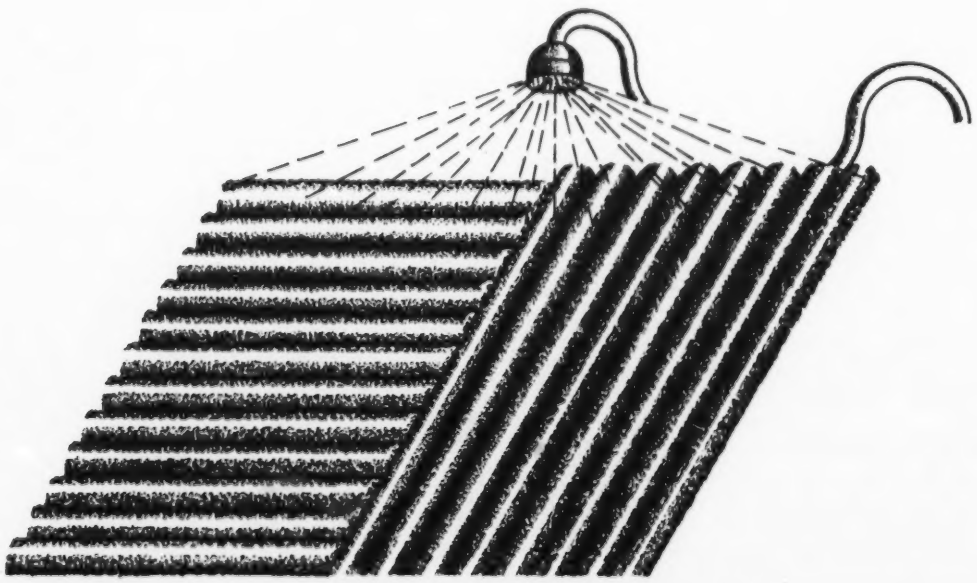
For outdoor use

You will need:

- a sloping area of bare land about 2 m x 2 m divided in two down the slope;
- garden hoe;
- hose with a sprinkler attachment;
- watch or clock with a second hand.

What to do:

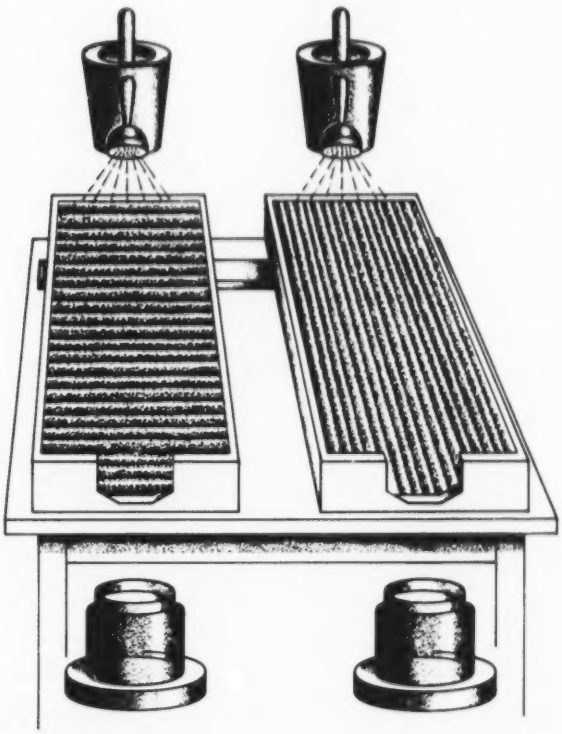
- With the hoe cut grooves 10 cm apart and about 2 cm deep across the slope on one plot and up and down the slope on the other.
- Water the plots equally with the sprinkler, applying water as natural rain would fall.
- Make careful notes of what happens, especially noting the time it takes in each case for water to reach the bottom.



For indoor use

You will need:

- two trays (see Section Three, Activity 1), filled with loose topsoil;
- six wooden blocks 2 cm x 2 cm x 30 cm;
- watering can fitted with a sprinkler attachment;
- two beakers, 500 cm^3, to collect run-off water;
- watch or clock with a second hand.



What to do:

- Cut grooves across the slope on one box and up and down slope on the other.
- Set the boxes up as shown.
- Water the boxes equally with the watering can, applying water as natural rain would fall.
- Make careful notes of what happens, especially noting the time it takes in each case for water to reach the bottom, and the amount of soil removed from each tray.

Answer these questions in your notebook:

(i) Did contour cultivation help control water movement? Soil movement? If so, how?

(ii) In which case was water absorbtion by the soil greater?

(iii) 'Slow down, spread out, soak in'. What does that statement mean in relation to soil conservation?

(iv) What do you think are the benefits and disadvantages of contour cultivation in a farm situation?

Does mulch help ?

When a crop is harvested, not all of the plant is taken. For example, when wheat is harvested, the stems are left behind. Similarly with other crops. And the reason for this is that man does not want to eat the whole plant, only a part of it.

This plant residue is called 'mulch'. One of three things can be done with mulch:

(1) it can be burnt off;
(2) it can be ploughed in; or
(3) it can be left on the surface.

What would you do?

This experiment will help you decide.

STUDENT ACTIVITY

For outdoor use

You will need:

- a sloping area of bare land about 2 m x 2 m, divided in two down the slope;
- grass clippings, straw, or leaves — enough to cover one plot;
- hose with a sprinkler attachment;
- garden hoe.

What to do:

- Loosen the surface soil on both plots to a fairly fine condition, without making definite furrows.
- Cover one plot with mulch.
- Water the plots equally with the sprinkler, applying water as natural rain would fall.
- Make careful notes of what happens; note amount of soil moved and rate of flow of water.

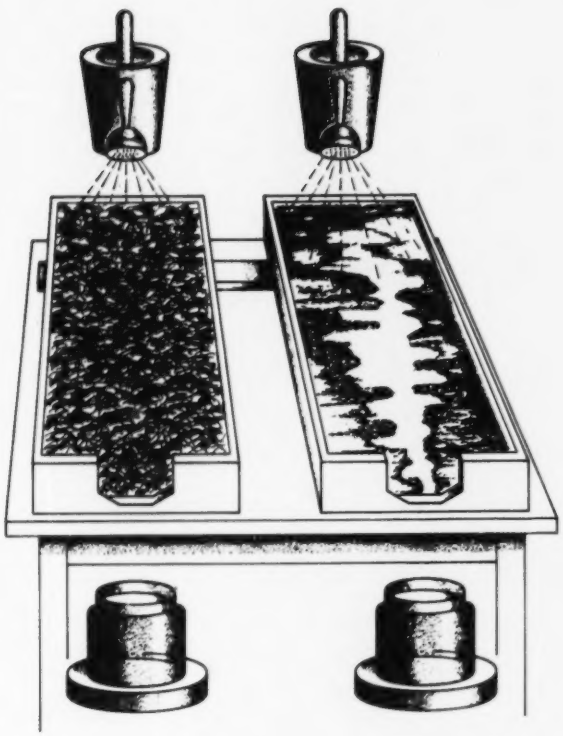
For indoor use

You will need:

- two trays (see Section Three, Activity 1), filled with loose topsoil;
- six wooden blocks, 2 cm x 2 cm x 30 cm;
- watering can with a sprinkler attachment;
- grass clippings, straw or leaves — enough to cover one tray;
- two beakers, 500 cm^3, to collect run-off water.

What to do:

- Set up trays as shown on page 21.
- Cover one soil tray with mulch.
- Water the plots equally with the watering can, applying water as natural rain would fall.
- Make careful notes of what happens; note the amount of soil moved and the rate of flow of water.



Answer these questions in your notebook:

(i) What erosion did you see in each case?

(ii) What effect did mulch have on soil erosion? How did it do this?

(iii) What effect did mulch have on retention of water in the soil? If any, why does it have this effect?

Section Six - PLANNING AVOIDS THE PROBLEM

Soil Management

A slide/tape set

In the previous section we learned of two simple ways by which soil can be saved on farm land: by contour cultivation and mulching. Of course we need to save soil wherever it is in danger of being lost.

However, CONTROLLING soil erosion is only one side of the coin. By careful planning – that is fitting land use to the features of the land – we can actually PREVENT soil erosion from ever becoming a serious problem.

Agricultural land only erodes when more is demanded of it than it is able to give. Classifying land by its features – (LAND CAPABILITY CLASSIFICATION) – is one way of ensuring that land owners know the 'limits' of their land's capabilities.

Land is put into one of seven classes. Class I land is 'ideal' land, deep, fertile, crumbly soil, well-drained and level, or nearly so. This land supports any form of agricultural production. Moving to Class II and below, soils become less and less fertile, shallower and more liable to erode, poorly drained and steeper. Also the climate becomes less favourable to plant growth. Thus Class VII land includes bare rocks, sand dunes and land covered with boulders. Its use is limited to recreation, water and wildlife conservation, rough grazing and forestry.

The slide/tape set, 'Soil Management' will present you with a range of soil saving measures, both on and off the farm.

STUDENT ACTIVITY

Before viewing the slides read over this list of questions – then after viewing the slides write the answers in your notebook.

(i) What is 'sod-seeding'? How does it differ from other means of pasture establishment? Why is soil erosion reduced by this means?

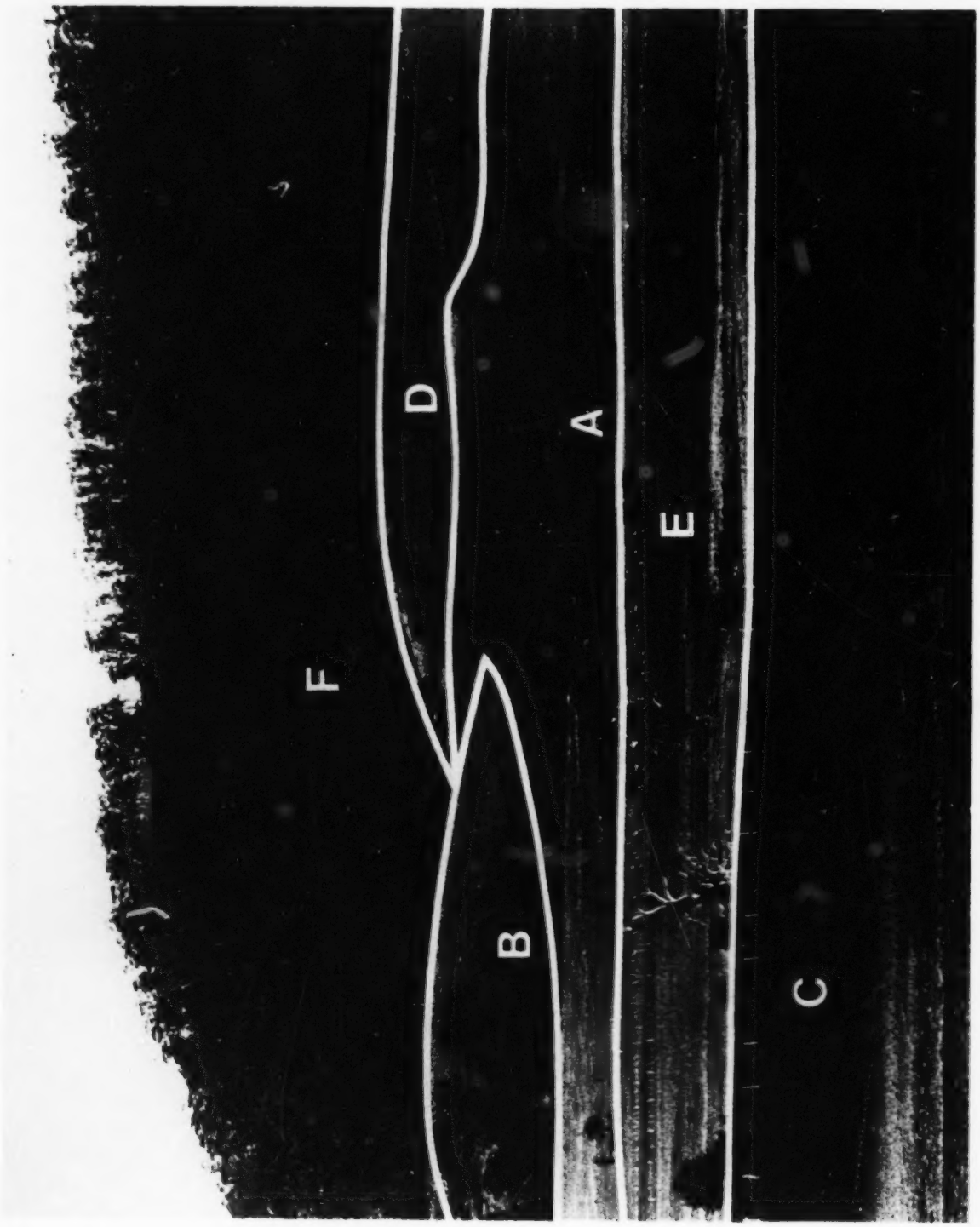
(ii) Plants play a very important part in erosion control. Name two ways they do this.

(iii) The boards pinned across the bushwalking track and the 'drop structures' alongside a new highway both make use of the same principle to save soil. What is that principle?

(iv) Name two ways of saving soil on roadside embankments.

(v) Present day soil erosion on farm land is much, much greater than before settlement by people from Britain and Europe. What has happened since their arrival to cause this?

(vi) The photograph on page 23 shows Land Class boundaries. Record in your notebook the class of each parcel of land, A to F.


F
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A
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